SPECIFICATION

METHOD OF OPERATING MULTI-INDUSTRY INTEGRATED COMPLEX FOR BASIC INDUSTRIAL PLANTS

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BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to location and construction of a plurality of the innovative layout and configurations of plants consisted of several industries such as oil refining plant, oil-fired or coal-fired power plant, cement and steelmaking plants.

DESCRIPTION OF THE RELATED ART

In 1950' in Japan, oil refining plants or petrochemical complexes are constructed so as to be adjacent to each other and alongside the sea. However, such complexes are only in consideration of delivery and receipt of raw materials for products, therefore, there are no significant consideration for these plants within complex and for utilization of energy such as power and fuel and/or waste materials between them.

Although there are cases that iron plants, steelmaking plants, and power plants are constructed so as to be adjacent to a petrochemical complex, each plant is independently arranged. Therefore, efficiency of energy utilization for heat and power is not so high on the whole. Moreover, waste materials are mostly transported to other places for disposal, and effective utilization of waste materials is not considered.

The patent on a combination of different kinds of plants is disclosed in Japanese Patent No.

2576006 as "Power generating method." A plant presented in this patent aimed to improve heat efficiency at power generation, and result in energy saving and prevention of global warming, in the plant which atmospheric distillation unit is co-mounted with a steam power generator and a gas turbine power generator using low sulfur crude oil.

Other patent is proposed of a system which is disclosed in Japanese Patent Publication (Unexamined) No. Heisei 9-87640 as "A residual oil treatment plant". In this patent, the plant is to generate power efficiently and effectively utilizing heat energy contained in residues and exhaust from a diesel engine.

On the other hand, a method, which is disclosed in Japanese Patent Publication (Unexamined) No. Showa 63-260982 as "A method of deoxidizing and supplying harmless pyrolytic gas from combustible organic waste materials" is also proposed to pyrolize and gasify combustible organic waste materials generated in an industrial park and to return this low-pressure gas containing hydrocarbon to factories and plants as fuel in the industrial park.

Further, in US Patent No. 5630862, a refinery and an iron-making process are combined to dispose of an environmentally undesirable material and to provide a novel fuel for an iron-making process.

Although the above-mentioned technologies have been proposed mainly to save energy, prevent global warming and generation of harmful materials through combination of plants and equipment, there has been no industrial complex in which large-scale plants for basic industrial products are combined so as to be adjacent to each other to completely and effectively utilize energy, byproducts as well as waste materials among them and to minimize the generation of harmful waste materials which are disposed of and treated outside.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of the above-mentioned problems and it is therefore an object of the present invention to provide an industrial complex for basic industrial products which includes oil refining plant, oil-fired power plant or coal-fired power plant, cement and steelmaking plants (hereinafter it is called as "Multi-Industry Integrated Complex: MIX), which efficiently utilizes energy, products, byproducts, and waste materials between the plants in the MIX, and totally improves energy efficiency within the MIX and mutually contributes to energy saving.

And further, the amount of harmful waste materials that are generated and are disposed of outside of the plant now in operation can be decreased in the MIX as small as possible, resulting in environment-friendly-type industrial complex.

Another object of the present invention is to provide a MIX in which transporters and a subsidiary facilities for the plants are commonly used, so that area required for the MIX may be decreased, resulting in efficient land utilization as well as reduced investment and running cost.

A further object of the present invention is to provide a MIX capable of collectively receiving raw materials for products and shipping products for each plant in the MIX, so that area required for the MIX may be decreased, resulting in efficient land utilization as well as reduced investment and running cost.

A still further object of the present invention is to provide a MIX capable of collectively shipping products in the MIX, which causes area required for the MIX to be decreased, resulting in efficient land utilization as well as reduced investment and running cost.

Another object of the present invention is to provide a MIX in which waste materials which are generated inside and/or outside of the MIX are used as side-raw-materials for other plants as possible. This results in providing environment-friendly-type industrial complex.

A further object of the present invention is to provide a MIX in which waste gas generated from the plants can collectively be used as useful materials, which allows area required for the further treatment facilities can be decreased, resulting in efficient land utilization as well as reduced investment and running cost.

A still further object of the present invention is to provide a MIX which can collectively dispose of waste gas from each plant of the MIX, so that area required for the MIX may be decreased, resulting in efficient land utilization as well as reduced investment and running cost.

Another object of the present invention is to provide a MIX capable of collectively treating the waste liquid generated from the plants, so that area required for the MIX may be decreased, resulting in efficient land utilization as well as reduced investment and running cost.

A further object of the present invention is to provide a MIX in which waste material generated from oil refining plant can be treated in the MIX, and heavy oil or residues generated in the plant are efficiently utilized in other plants in the MIX, so that the amount of harmful waste materials that are disposed of outside of the MIX can be decreased as small as possible, which makes it possible to conduct environment-friendly-type total regional development.

A still further object of the present invention is to provide a MIX capable of efficiently utilizing heavy oil or residues from the oil refining plant as products, and power and heat from the oil-fired power plant in the other plants in the MIX, which totally improves energy efficiency of the MIX and contributes to energy saving.

Another object of the present invention is to provide a MIX in which heat from the oil-fired power plant is efficiently recycled in the oil refining plant in the MIX, which totally improves energy efficiency of the MIX and contributes to energy saving.

A further object of the present invention is to provide a MIX in which byproduct and waste

material from the steelmaking plant are efficiently recycled in the MIX, which totally improves energy efficiency of the MIX and contributes to energy saving.

A still further object of the present invention is to provide a MIX capable of utilizing, in the cement plant, products, waste materials, which totally improves energy efficiency of the MIX and contributes to energy saving.

Another object of the present invention is to provide a MIX in which products and waste materials from the coal-fired power plant is efficiently recycled in the MIX, which totally improves energy efficiency of the MIX and contributes to energy saving; and the amount of harmful waste materials that are disposed of outside of the MIX can be decreased as small as possible, which makes it possible to conduct environment-friendly-type regional development.

To achieve the above-mentioned objectives, a MIX according to the present invention comprises basic industrial plants including an oil refining plant, an oil-fired power plant, a cement plant, a steelmaking plant constructed so as to be in close proximity to or adjacent to each other, wherein the basic industrial plants are combined through a transporter for partially or completely supplying product, byproduct or waste material from a plant in the MIX as a fuel, power source, and/or raw material for products for another plant in the MIX.

The basic industrial plants described above may be located alongside the sea and have a common port facility.

Further, it is possible to construct a product delivery facility for supplying products from the basic industrial plants to outside of the MIX.

Still further, a common waste material treatment facility can be constructed to treat waste materials generated inside and/or outside of the MIX.

Further, the MIX described above may have a common waste gas treatment facility for the

exhaust gases as gaseous waste from the oil refining plant, the oil-fired power plant, the cement plant, and/or the steelmaking plant.

It is further possible to desulfurize, in the MIX, the exhaust gases as gaseous waste generated from the oil refining plant, the oil-fired power plant, the cement plant, and the steelmaking plant in the waste gas treatment facility in one lot to remove harmful materials, and one of the transporters may supply gypsum as byproduct from the waste gas treatment facility to the cement plant.

Still further, a common waste liquid treatment facility can be constructed to treat, in one lot, waste liquid generated from the oil refining plant, the oil-fired power plant, the cement plant, and the steelmaking plant can remove harmful materials, and for supplying sludge containing the harmful materials to the cement plant.

Further, it is possible that the oil refining plant uses crude oil as a raw material, and produces gasoline, kerosene, gas oil, and residues, which are obtained after hydrodesulfurizing fractions other than residues in one lot through atmospheric distillation, and is provided with one of the transporters for supplying at least one of sludge from storage tanks for the products, spent catalyst waste and waste gas from the hydrodesulfurizing facility to the cement plant, and is provided with one of the transporters for supplying the heavy oil or residues as fuel to at least one of the oil-fired power plant, the cement plant, and the steelmaking plant.

Still further, in the MIX described above, the oil-fired power plant may use heavy oil or residues as fuel from the oil refining plant as products to produce power as product, and may be provided with one of the transporters for supplying power to the oil refining plant, the cement plant, and the steelmaking plant.

The above-mentioned oil-fired power plant may be provided with one of the transporters

for supplying steam or hot water as heat to the oil refining plant.

Further, in the MIX, the steelmaking plant can produce steel products from scrap as a main raw material in an electric arc furnace, and may be provided with one of the transporter for supplying slag and dust generated from the steelmaking plant to the cement plant.

Still further, in the MIX described above, it is possible that the cement plant uses limestone as a main raw material to mainly produce Portland cement, and uses heavy oil or residues, and waste gas from the oil refining plant as fuel in a burning process thereof, and further uses as an auxiliary raw material or a part of fuel at least one of the spent catalyst waste from the oil refining plant, the drain sludge from the storage tanks, the slag and dust from the steelmaking plant, the gypsum from the waste gas treatment facility as byproduct, and the sludge from the waste liquid treatment facility.

Further, in order to achieve the above-mentioned objectives, a MIX according to the present invention comprises basic industrial plants including a coal-fired power plant, a cement plant, a steelmaking plant constructed so as to be in close proximity to or adjacent to each other, wherein the basic industrial plants are combined through a transporter for partially or completely supplying product, byproduct or waste material from a plant in the MIX as a fuel, power source, and/or raw material for products for another plant in the MIX.

The basic industrial plants described above may be located alongside the sea and have a common port facility.

Further, it is possible to construct a product delivery facility for supplying products from the basic industrial plants to outside of the MIX.

Still further, a waste material treatment facility can be constructed to treat waste materials generated inside and/or outside of the MIX.

Further, the MIX described above may have a waste gas treatment facility for treating, in

one lot, exhaust gas as gaseous waste from the coal-fired power plant, the cement plant, and the steelmaking plant.

It is further possible to desulfurize, in the MIX, the exhaust gas as gaseous waste generated from the coal-fired power plant, the cement plant, and the steelmaking plant in the waste gas treatment facility in one lot to remove harmful materials, and one of the transporters supplies gypsum as byproduct from the waste gas treatment facility to the cement plant.

Still further, a waste liquid treatment facility can be constructed to treat, in one lot, waste liquid generated from the coal-fired power plant, the cement plant, and the steelmaking plant can remove harmful materials, and for supplying sludge containing the harmful materials to the cement plant.

Further, it is possible that the coal-fired power plant uses coal as fuel to produce power, and is provided with one of the transporters for supplying power to the steelmaking plant and the cement plant, and is further provided with one of the transporters for supplying coal ash generated from the coal-fired power plant to the cement plant.

Still further, in the MIX described above, the steelmaking plant may produce steel products from scrap as a main raw material in an electric arc furnace, and may be provided with one of the transporters for supplying slag and dust generated from the steelmaking plant to the cement plant.

Still further, in the MIX described above, it is possible that the cement plant uses limestone as a main raw material to mainly produce Portland cement, and uses, as an auxiliary raw material or a part of fuel, at least one of the coal ash from the coal-fired power plant, the slag and dust from the steelmaking plant, the gypsum from the waste gas treatment facility as byproduct, and the sludge from the waste liquid treatment facility.

BRIEF DESCRIPTION OF THE DRAWING

The present invention will be more apparent from the ensuring description with reference to the accompanying drawings, wherein:

Figure 1 is a schematic view of the overall construction of the MIX according to the first embodiment of the present invention;

Figure 2 is a schematic view showing material flow of an oil refining plant constituting the MIX according to the present invention;

Figure 3 is a schematic view showing material flow of an oil-fired power plant constituting the MIX according to the present invention;

Figure 4 is a schematic view showing material flow of a cement plant constituting the MIX according to the present invention;

Figure 5 is a schematic view showing material flow of a steelmaking plant constituting the MIX according to the present invention;

Figure 6 is a schematic view showing material flow between the plants in the complex of the MIX according to the first embodiment of the present invention;

Figure 7 is a schematic view of the overall construction of the MIX according to the second embodiment of the present invention;

Figure 8 is a schematic view showing material flow in a coal-fired power plant constituting the MIX according to the second embodiment of the present invention; and

Figure 9 is a schematic view showing material flow in the complex of the MIX according to the second embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Next, embodiments of the MIX according to the present invention will be explained with reference to drawings.

Figure 1 is a schematic view of the overall configuration of a MIX according to the first embodiment of the present invention. In this embodiment, MIX 1 is mainly composed of an oil refining plant R, an oil-fired power plant P, a cement plant C, and a steelmaking plant S, and the MIX 1 comprises a complex 2 in which the above-mentioned plants are constructed so as to be in close proximity to or adjacent to each other; a transporter 3 for completely or partly supplying products, byproducts or waste materials from a plant in the complex 2 to another plant of the complex 2 as a fuel, power source, and raw material for product; a common port facility 4 for collectively receiving raw materials for products and shipping products for each plant in the complex 2; a product delivery facility 5 for supplying products from each plant in the complex 2 to urban communities 20, industrial parks 30 in which other industrial plants are concentrated, an airport 40 and so on; and a waste material treatment facility 6 for treating waste from the urban communities 20, the industrial parks 30, the airport 40 and the like.

The oil refining plant R is, as illustrated in Fig. 2, a plant that uses crude oil Rr as a raw material, and produces gasoline Pr1, kerosene Pr2, gas oil Pr3, and residues Pr4, which are obtained after hydrodesulfurizing fractions other than residues in one lot through atmospheric distillation. In addition to the above, LP gas not shown may be obtained. From storage tanks for each product, sludge Wr1 is generated as a waste product, and from a hydrodesulfurization unit not shown in the oil refining plant R is generated spent catalyst waste Wr2, acid gas Wr3 as a gaseous waste and waste liquid Wr4 at the same time. Further, in the atmospheric distillation process and the like, exhaust gas Gr is generated. In this connection, the waste materials Wr1 to Wr4 and the exhaust gas

Gr have conventionally been treated independently outside of the plant in some cases. Products containing all the residues and a part of the residual oil may generally be called heavy oil, however, residues in the explanation described below includes the heavy oil defined above.

The oil-fired power plant P, as illustrated in Fig. 3, generates power Pp by rotating a turbine with steam generated from the residues Fp or heavy oil, simultaneously generates exhaust gas Gp through the combustion of the residues and the heavy oil Fp and the like as well as the waste liquid Wp. Conventionally, both the exhaust gas Gp and the waste liquid Wp have been treated in the plant.

Further, the cement plant C is, as illustrated in Fig. 4, a plant that mainly produces Portland cement by adding gypsum Rc2 and the like to cement clinker which is obtained through burning of raw materials such as limestone Rc1 and the like with heavy oil Fc as fuel; at the same time, conventionally, it is required, independently and outside of the plant, to exhaust gas Gc generated from a kiln not shown and the like, and to exhaust liquid Wc from other equipment in the plant.

Still further, the steelmaking plant S is, as illustrated in Fig. 5, a plant that produces steel products from scrap Rs as the main raw material while consuming power Es and heavy oil Fs as fuel in an electric arc furnace, and in the same manner as the above-mentioned plants, exhaust gas Gs is generated, and slag Ws1, dust Ws2, and exhaust liquid Ws3 are generated, and conventionally, the gaseous waste materials Gs, solid waste materials Ws1, Ws2, and waste liquid Ws3 have independently been treated outside of the plant in some cases.

The transporter 3 in Fig. 1 is constructed or arranged between the plants in the complex 2, and for example, in case of transporting fluid such as fuel, the transporter 3 comprises pipe lines, and when electrical power is transported, the transporter 3 comprises electric wires, and when other byproducts, waste materials and the like are transported the transporter 3 comprises belt conveyors,

trucks, wagons and the like; a suitable means of transport is selected in accordance with the object transported.

The common port facility 4 is constructed so as to be adjacent to the complex 2 to receive raw material for products for each plant in the complex 2 and to deliver products from each plant, so that the common port facility 4 is commonly used for the plants in the complex 2.

The product delivery facility 5 is, as explained above, mounted to supply gasoline, kerosene, gas oil, and further power, hot water, and steam and so on as products from each plant in the complex 2 to the urban communities 20, industrial parks 30 in which other industrial plants are concentrated, airport 40 and so on. With this product delivery facility 5, not only are products from the respective plants once collected at the product delivery facility 5 via the transporter 3 delivered to the urban communities 20 and the like, but also it is a matter of course that products from respective plants are delivered directly to the urban communities 20 and the like.

Further, the waste material treatment facility 6 is also constructed to recycle waste materials generated at the urban communities 20, the industrial parks 30, the airport 40 and so on. In this case, waste materials from the urban communities 20 and the like are collected at the waste material treatment facility 6 once, and are recycled after transport to each plant in the complex 2 via the transporter 3. For example, when the waste material treatment facility 6 is a furnace, required power is obtained from oil-fired power plant P, and ash from the furnace can be recycled in the cement plant C also. In addition to this, it is possible to recycle waste materials from the urban communities 20 and the like after direct transport to each plant also, as a matter of course.

Next, the flow of material between the plants in the complex 2 of the MIX according to the first embodiment of the present invention will be explained together with other facilities in the complex 2 with reference to Fig. 6.

The waste liquid treatment facility 8 treats, in one lot, waste liquids from the oil refining plant R, the oil-fired power plant P, the cement plant C, and the steelmaking plant S to remove harmful materials, and discharges water treated outside of the system, and simultaneously supplies sludge W8 with harmful materials to the cement plant C.

The waste gas treatment facility 9 treats, in one lot, exhaust gas as gaseous waste from the oil refining plant R, the oil-fired power plant P, the cement plant C, and the steelmaking plant S to remove harmful materials such as NOx and SOx and discharge treated gas from a stack outside of the system, and simultaneously recycles gypsum W9 that is obtained after desulfurization as a byproduct to the cement plant C.

As described above, the oil refining plant R produces gasoline Pr1, kerosene Pr2, gas oil Pr3, and residues Pr4 and the like from crude oil Rr as a raw material, and the residues Pr4 are supplied to the oil-fired power plant P, the cement plant C, and the steelmaking plant S through pipe lines not shown as the transporter 3, or residues Pr4 are transported to respective tanks for respective plants.

Further, sludge Wr1, spent catalyst waste Wr2, acid gas Wr3 that are generated in the oil refining plant R are supplied to the cement plant C as an auxiliary raw material or a fuel. Therefore, these waste materials, which have conventionally been disposed of independently outside of the plant, can completely or partly be recycled in the complex 2.

Still further, the waste liquid Wr4 is treated in the waste liquid treatment facility 8 which is commonly used for respective plants in the complex 2. On the other hand, exhaust gas Gr generated in the oil refining plant R is treated at the waste gas treatment facility 9 which is commonly used for respective plants in the complex 2.

As described above, the oil-fired power plant P generates power Pp by rotation of a turbine by steam generated from heavy oil or residues Fp. This heavy oil or residues Fp are the residues

Pr4 which are supplied from the oil refining plant R through pipe lines as the transporter 3. In addition, in the oil-fired power plant P also, in the same manner as the oil refining plant R, waste liquid Wp is treated at the waste liquid treatment facility 8, and exhaust gas Gp at the waste gas treatment facility 9.

The steelmaking plant S produces the product Ps from scrap Rs as a raw material through an electric arc furnace, a continuous foundry, and a rolling mill. The power Es consumed in the electric arc furnace, the continuous foundry, and the rolling mill is supplied from the oil-fired power plant P through electrical wires as the transporter 3. Further, as the heavy oil Fs consumed in the plant, residues Pr4 supplied from the oil refining plant R through the transporter 3 is used. Still further, slag Ws1 and dust Ws2 that are generated in the steelmaking plant S are recycled by using them as raw materials in the cement plant C. As a result, with the present invention, the slag Ws1 and dust Ws2, which have conventionally been disposed of independently outside of the steelmaking plant S, can be recycled within the complex 2.

As described above, the cement plant C mainly produces Portland cement Pc by adding gypsum Rc2 and the like to cement clinker which is obtained through burning of raw materials such as limestone Rc1 with heavy oil Fc as fuel. This gypsum Rc2 is supplied from the waste gas treatment facility 9. Further, in addition to limestone Rc1, the sludge Wr1 and spent catalyst waste Wr2 that are generated in the oil refining plant R are used as raw materials. Still further, the slag Ws1 and dust Ws2 that are generated in the steelmaking plant S described below as a byproduct and a waste material are used as raw materials. As a result, it is possible to completely or partially recycle within the complex 2 byproducts and waste materials generated from the oil refining plant R and the steelmaking plant S.

Further, in the cement plant C, the heavy oil Fc used as a fuel is the residues Pr4 that are

supplied from the oil refining plant R through pipe lines as the transporter 3; in the same manner, acid gas Wr3 generated from the oil refining plant R can be used as a fuel. As a result, with the present invention, the acid gas Wr3, which has conventionally been treated independently outside of the oil refining plant R, can be treated within the complex 2.

Further, in the cement plant C also, the waste liquid Wc is treated in the waste liquid treatment facility 8, and the exhaust gas Gc in the waste gas treatment facility 9.

As explained above, in each plant in the complex 2, energy and fuel are efficiently utilized, and waste gas and waste liquid generated in the complex 2 are respectively treated in the waste liquid treatment facility 8 and the waste gas treatment facility 9 so as to become harmless, and gypsum as a byproduct and drain sludge are efficiently used for a part of raw materials for cement.

As described above, with the present invention, it becomes possible to efficiently utilized energy, products, byproducts, and waste materials between the plants in the MIX as a whole, and to decrease the amount of harmful materials that are disposed of outside of the MIX as small as possible. Further, transporters and a management facility for the plants are commonly used in the MIX.

Further, with the present invention, since the plants in the MIX are located alongside the sea, and have a common port facility, it becomes possible to collectively receive raw materials for products and ship products for each plant in the MIX.

Still further, with the present invention, a product delivery facility is constructed to supply products from the plants in the MIX to outside of the MIX, which causes products to collectively shipped in the MIX.

With the present invention, a waste material treatment facility is constructed to treat waste materials generated inside and/or outside of the MIX, which makes it possible to conduct

environment-friendly-type total regional development.

Further, with the present invention, a waste gas treatment facility is constructed to treat, in one lot, exhaust gas as gaseous waste from each plant in the MIX, so that the waste gas generated from the plants can collectively be disposed of.

Still further, with the present invention, the exhaust gas as gaseous waste generated from each plant in the MIX is desulfurized in the waste gas treatment facility in one lot to remove harmful materials, and one of the transporter supplies gypsum as byproduct from the waste gas treatment facility to the cement plant, which makes it possible to decrease the amount of harmful materials that is disposed of outside of the MIX as small as possible.

With the present invention, a waste liquid treatment facility is constructed to treat, in one lot, waste liquid generated from each plant in the MIX to remove harmful materials, and supply sludge containing the harmful materials to the cement plant, which makes it possible to collectively treat the waste liquid generated from the plants and decrease the amount of harmful materials that are disposed of outside of the MIX as small as possible.

Further, with the present invention, since at least one of sludge from storage tanks of the oil refining plant, spent catalyst waste and waste gas from the hydrodesulfurizing unit can be supplied to the cement plant, and heavy oil or residues can be supplied to at least one of the oil-fired power plant, the cement plant, and the steelmaking plant, waste materials generated from the oil refining plant can be treated in the MIX, and heavy oil or residues generated in the plant are efficiently utilized in other plants in the MIX.

Still further, with the invention, it is possible to efficiently utilize heavy oil or residues from the oil refining plant as products, and power and heat from the oil-fired power plant in the other plants in the MIX.

With the present invention, the oil-fired power plant is provided with one of the transporter for supplying steam or hot water as heat to the oil refining plant, so that the heat from them the oil-fired power plant is efficiently recycled in an atmospheric distillation unit and the like of the oil refining plant in the MIX.

Further, with the present invention, the steelmaking plant is provided with one of the transporter for supplying slag and dust generated from the steelmaking plant to the cement plant, which allows the slag and dust generated from the plant as byproduct and waste material to be efficiently recycled in the cement plant in the MIX.

Still further, with the present invention, it is possible to utilize, in the cement plant, products, waste materials from the other plants in the MIX as auxiliary material or fuel, allowing energy, products, and waste materials to efficiently be utilized in the MIX, and permitting the amount of harmful materials that are disposed of outside of the MIX to be decreased.

Figure 7 is a schematic view of the overall configuration of a MIX according to the second embodiment of the present invention. In this embodiment, the MIX 11 is mainly composed of a coal-fired power plant P', the cement plant C, and the steelmaking plant S, and the basic plant complex 11 comprises a complex 12 in which the above-mentioned plants are constructed so as to be in close proximity to or adjacent to each other; the transporter 3 for completely or partially supplying products, byproducts or waste materials from a plant in the complex 12 to another plant of the complex 12 as a fuel, power source, and/or a raw material for product; the common port facility 4 for collectively receiving fuel and raw material for products and shipping products for each plant in the complex 12; the product delivery facility 5 for supplying products from each plant in the complex 12 to the urban communities 20, the industrial parks 30 in which other industrial plants are concentrated, the airport 40 and so on; and the waste material treatment facility 6 for treating waste

materials from the urban communities 20, the industrial parks 30, the airport 40 and the like. In this embodiment, like components as described in the first embodiment are indicated as like reference symbols, and detailed explanation thereof will be omitted.

The coal-fired power plant P', as illustrated in Fig. 8, uses coal Fp' as a fuel to generate power Pp' by rotating a turbine using steam generated, and at the same time, exhaust gas Gp' generated by the combustion of the coal Fp'; further, coal ash Wp'1 and waste liquid Wp'2 are generated from burning equipment and so on, which have conventionally independently been treated and been disposed of outside of the plant.

Further, as illustrated in Fig. 9, the cement plant C and the steelmaking plant S are constructed in the same manner as those shown in the first embodiment. However, in both plants C, S, heavy oil is not used as a fuel, but the coal Fp' that is used as a fuel in the coal-fired power plant P' is used as fuel Fc' and Fs'.

The transporter 3 illustrated in Fig. 7 is installed or arranged between the plants in the complex 12, and in this embodiment, the transporter 3 comprises belt conveyors or trucks to handle coal as fuel, electric wires to supply electric power, belt conveyors, trucks, wagons and so on to transport other byproducts, waste materials, and so on; that is, a suitable transporter is selected in accordance with the object transported. The common port facility 4, the product delivery facility 5, and the waste material treatment facility 6 also are constructed in the same manner as the first embodiment.

Next, the flow of material between the plants in the complex 12 of the MIX according to the second embodiment of the present invention will be explained together with other facilities in the complex 12 with reference to Fig. 9.

The waste liquid treatment facility 8 treats, in one lot, waste liquid from the coal-fired power

plant P', the cement plant C, and the steelmaking plant S to remove harmful materials, and discharge water treated outside of the system, and simultaneously supply sludge W8 with the harmful materials to the cement plant C.

The waste gas treatment facility 9 treats, in one lot, exhaust gas as gaseous waste from the coal-fired power plant P', the cement plant C, and the steelmaking plant S to remove harmful materials such as NOx and SOx and discharge gas treated from a stack outside of the system, and simultaneously supply gypsum W9 that is obtained after desulfurization as a byproduct to the cement plant C.

As described above, the coal-fired power plant P' generates power Pp' by rotation of a turbine by steam generated from coal Fp' as a fuel. This coal Fp' is received from the common port facility 4 (shown in Fig. 7) . Coal ash Wp'1 that is generated in the coal-fired power plant P' is recycled as a raw material for product in the cement plant C, and the exhaust gas Gp' is treated in the waste gas treatment facility 9.

The steelmaking plant S produces, in the same manner as the first embodiment, the product Ps from scrap Rs as a raw material through an electric arc furnace and a rolling mill. The power Es consumed in the electric arc furnace and the rolling mill is supplied from the coal-fired power plant P' through electrical wires as the transporter 3. Further, the slag Ws1 and dust Ws2, which are generated in the steelmaking plant S, are recycled by using them as raw materials in the cement plant C.

The cement plant C mainly produces Portland cement by adding gypsum Rc2 to cement clinker which is obtained through burning of raw material such as limestone Rc1 and the like with coal Fc' as fuel. This gypsum Rc2 is, like the first embodiment, supplied from the waste gas treatment facility 9. Further, in addition to limestone Rc1 and the like, coal ash Wp'1 generated in

the coal-fired power plant P' is used as a raw material. The slag Ws1 and dust Ws2 that are generated in the steelmaking plant S described below as a byproduct and a waste material are also usable as raw materials. As a result, it is possible to completely or partially recycle or treat in the complex 12 byproducts and waste materials that are generated in the coal-fired power plant P' and the steelmaking plant S.

Further, in the cement plant C, coal that is received from the common port facility 4 via belt conveyors or the like as the transporter 3 is used as the coal Fc' as a fuel. Still further, in the cement plant C also, the waste liquid Wc is treated in the waste liquid treatment facility 8, and the waste gas Gc in the waste gas treatment facility 9.

As described above, energy and fuel are efficiently utilized in each plant in the complex 12, and waste gas and waste liquid that are generated in the complex 12 are respectively treated in the waste liquid treatment facility 8 and the waste gas treatment facility 9 so as to become harmless, and simultaneously gypsum as a byproduct and drain sludge are efficiently utilized as a part of raw materials for cement.

Further, in this embodiment, in each plant in the complex 12, coal is used as a fuel, so that waste materials generated in the complex 12 are substantially recycled or treated in the complex 12, and it is unnecessary to treat the waste materials outside of the complex 12.

With the present invention, it becomes possible to efficiently utilized energy, products, byproducts, and waste materials between the plants in the MIX as a whole, and to decrease the amount of harmful materials that are disposed of outside of the MIX as small as possible. Further, transporters and a management facility for the plants are commonly used in the MIX.

Further, with the present invention, since the plants in the MIX are located alongside sea and have a common port facility, it becomes possible to collectively receive raw materials for

products and ship products for each plant in the MIX.

Still further, with the present invention, a product delivery facility is constructed to supply products from the plants in the MIX to outside of the MIX, which causes products to collectively shipped in the MIX.

With the present invention, a waste material treatment facility is constructed to treat waste materials generated inside and/or outside of the MIX, which makes it possible to conduct environment-friendly-type total regional development.

Further, with the present invention, a waste gas treatment facility is constructed to treat, in one lot, exhaust gas as gaseous waste from each plant in the MIX, so that the waste gas generated from the plants can collectively be disposed of.

Still further, with the present invention, the exhaust gas as gaseous waste generated from each plant in the MIX is desulfurized in the waste gas treatment facility in one lot to remove harmful materials, and one of the transporter supplies gypsum as byproduct from the waste gas treatment facility to the cement plant, which makes it possible to decrease the amount of harmful materials that are disposed of outside of the MIX as small as possible.

With the present invention, a waste liquid treatment facility is constructed to treat, in one lot, waste liquid generated from each plant in the MIX to remove harmful materials, and supply sludge containing the harmful materials to the cement plant, which makes it possible to collectively treat the waste liquid generated from the plants and decrease the amount of harmful materials that are disposed of outside of the MIX as small as possible.

Further, with the present invention, power from the coal-fired power plant is supplied to the steelmaking plant and the cement plant, and coal ash from the coal-fired power plant is supplied to the cement plant, so that in the MIX energy can efficiently be utilized as a whole, and the amount

of harmful waste material that is disposed of outside of the MIX can be decreased as small as possible.

Still further, with the present invention, one of the transporter supplies the slag and dust generated from the steelmaking plant to the cement plant, which makes it possible to efficiently recycle the slag and dust generated from the plant as byproduct and waste material in the cement plant in the MIX.

With the present invention, it is possible to utilize, in the cement plant, waste materials from the other plants in the MIX as auxiliary material or fuel, allowing waste materials to efficiently be utilized in the MIX, and permitting the amount of harmful materials that are disposed of outside of the MIX to be decreased.